FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

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DIARY OF FORTHCOMING EVENTS

Club Secretaries and others desirous of announcing the dates of important fixtures are invited to send particulars for inclusion in the following list:—

1924

Sept. 5	Entries Close at Double Fees for Light 'Plane Competition at Lympne.
Sept. 27–28	Eliminating Tests for Light 'Plane Competition at Lympne.
,, 27–Oct. 8	Wireless Exhibition at Albert Hall, Kensington.
,, 29–Oct. 4	2-Seater Light 'Plane Competition at Lympne.
Oct. 2	Aero Golfing Society. Autumn Meeting, at Moor Park Golf Club, for A.G.S. Challenge Cup presented by Cellon (Richmond) Ltd.
,, 2	Lieut.-Col. H. T. Tizard, A.F.C., F.R.Ae.S. (of the Department of Scientific and Industrial Research), Chairman: Inaugural Lecture.
,, 4	Grosvenor Challenge Cup Race at Lympne.
,, ...	Schneider Cup Race, Baltimore.
,, 16	Dr. A. Rohrbach (of the Rohrbach Metall-Flugzeugbau Co.) "Large All-Metal Seaplanes," before R.Ae.S.
,, 30	Major J. S. Buchanan, A.F.R.Ae.S. (of the Technical Department, Air Ministry): "The R.Ae.C. Light Aeroplane Competitions," before R.Ae.S.
Dec. 5–21	Paris Aero Show.

EDITORIAL COMMENT.

AN interesting suggestion is made in a communication from Commander F. L. M. Boothby to the effect that it might be possible to form what he terms "an airship yachting club." Commander Boothby points out that at the time when the late Sir Ross Smith was planning his world-flight it was hoped that it might be possible to arrange for an airship to attempt the flight at the same time, the airship to start six weeks after the departure of the aeroplane, and, flying the more direct route *via* Siberia to Japan, joining the aeroplane there and escorting it across the foggy regions in the Pacific. Although the Americans promised every assistance—Commander Boothby pays high tribute to their great sportsmanship—the British Air Ministry was not, he says, helpful, and no British sportsmen with the necessary money could be found.

Airship Racing?

"Fortunately," Commander Boothby's communication continues, "a new generation now rules in the Air Ministry. They regret, almost as much as the old airship officers, the ruthless policy of destruction waged on airships by the military party that got control of the Royal Air Force after the Armistice."

Commander Boothby points out that there is an "internationalised" airship shed on Lake Constance from which all Europe could be covered, and that shortly there will be a base in Egypt and India from which cruises could be carried out. Continuing, Commander Boothby writes:

"I wish to appeal to British sportsmen to found an airship yachting club. For £20,000 we can buy a 7-ton yacht operating on heavy oil at 5*d.* a gallon, so abolishing the costly and dangerous petrol. She would carry 20 passengers at 70 m.p.h. Are there not 20 men and women in England who could find £1,000 apiece? Alternatively, we could get four small airships of 2 tons each and start class racing—probably a more attractive proposition than the first. The Air Ministry look on the idea with favour, and, I am sure, would lend every assistance. Flying low and slow in a small airship, with hardly a sound from the engine ticking over, watching the bird life in the tree tops, or having a word with the trawlers at sea, is one of the most pleasurable forms of sport in existence, and no more difficult or dangerous than

ordinary yachting. A challenge to America to race 2-ton airships round St. Paul's and the Eiffel Tower would not go without its response, we may be sure. Better to buy an air yacht and fly it yourself than a racehorse and watch someone else ride it! Will those who agree with me write to me at the Royal Aero Club, with a view to forming a committee to start this new sport?"

The idea of an airship yachting club would appear to have a good deal to recommend it, but it cannot be denied that there are very considerable difficulties in the way of its successful accomplishment. To begin with, the initial cost of such a ship is fairly high. Commander Boothby himself places the price at £20,000 for a 7-ton airship. Then there is the question of hangar accommodation, of hydrogen supply, and of general maintenance and repairs. Taking it all round, these would be fairly expensive items, and to us it seems likely that Commander Boothby's alternative suggestion—the purchase of four smaller ships of 2 tons each—is more likely to recommend itself to potential air yachtsmen.

In the first place, it would not be necessary to start with four ships straight away. One small ship could be purchased for a start, and then as interest grew, as it almost surely would do, more ships could be added to the fleet. The idea of class-racing, as with yachts and boats, seems certainly more attractive; the housing problem would be rendered rather more easy of solution, and the initial cost and maintenance charges would be within reach of practical politics.

The scheme should be of very considerable value to the Air Ministry in connection with the new airship policy, as affording, if nothing more, an opportunity for the training of airship pilots and other personnel. It must, of course, be realised that it is of little use building airships of 5,000,000 cub. ft. capacity unless we have also the personnel for their successful operation, and by the time these giants have materialised it will be a matter of eight years or so since the last British airship pilot took up a ship. What that means should be obvious without elaborating the point.

By way of showing what can be done even in a very small way, we publish this week a short article and two illustrations of the new Italian "light airship" the "Mr." This airship is claimed to be, and probably is, the smallest practical airship in the world. We do not suggest that for the "airship yachting club" proposed by Commander Boothby a type of this small size should be adopted, but the article does serve to illustrate that an airship need not be either very large or very costly. With its 40 h.p. engine the "Mr." puts up 40 m.p.h., which is, of course, a very low speed, and might be too low in countries where any appreciable head-wind is likely to be encountered. A slightly larger type, with correspondingly greater engine power, should, however, be capable of flying on a very good percentage of the days in a year, and should certainly, as Commander Boothby points out, provide glorious sport. Incidentally, it would be interesting to know what happened to the various "Blimps" and other small craft after the War. With their B.E. fuselages and 70 h.p. engines these small airships did very good work, and it should be possible, in the light of more modern knowledge, to produce small ships with considerably better performance, and, by adopting Commander Boothby's heavy oil engines burning oil costing 5*d.* per gallon, with increased safety and at greatly reduced cost. If the feature of a layer of inert gas around the balloonettes could also be incorporated, such ships should be to all intents and purposes immune from fire risk, hitherto probably the greatest danger of all in connection with airships. Commander Boothby's suggestion is worthy of careful consideration, and it should not be impossible to get together the necessary capital to start with one small airship.

Light 'Planes as Flying Models

While in this country attention to the development of the light 'plane has, up to the present, been entirely confined to the sporting side, there is another sphere of usefulness which the light 'plane appears to be capable of successfully and economically fulfilling—*i.e.*, that of providing data for the design of much larger and more powerful machines. In other words, the light 'plane could—and, we think, should—be used as a flying scale model. Considerable doubt still exists as to the validity of the results obtained with small-scale models in wind tunnels, and apart from such problems as scale effects, there is a growing need for model tests which include the effects of the airscrew. It is possible, and in fact has been done, to mount a scale model in a large wind tunnel and to provide means for running the airscrew of the model at a speed corresponding to the air speed in the tunnel, and thus to obtain measurements of the forces acting on the model. Such tests, however, are not only rather difficult to carry out, but are also very expensive, while such subjects as stability and manœuvrability really require an actual flying model. For such work we believe the light 'plane could be successfully used, and in this week's issue of FLIGHT we publish Part II of American Technical Note No. 190, by Edward P. Warner, which deals with the practical side of the subject of geometrically similar aeroplanes. Part I, by Max Munk, is a mathematical analysis of the subject.

There is one subject uppermost in the minds of all interested in aviation at the present time, that of controllability at stalling speed, and it would appear that light 'planes might be used to advance our knowledge of this subject in a short space of time, at small cost and, last but not least, with comparative safety to the experimental pilot.

Air Parcels for Rhine Army

THE Postmaster-General announces that from Monday, August 25, parcels addressed to the British Army of the Rhine or to the British Commissions in Germany may be posted for onward transmission from London to Cologne by the morning aeroplane service of Imperial Airways, Ltd. Parcels posted early enough to connect with the next morning's air despatch from London will commonly be delivered on the day after posting.

The special fee payable (inclusive of inland as well as air conveyance) will be as follows:—Up to 2 lbs., 2*s.*; 2-7 lbs., 5*s.* 6*d.*; 7-11 lbs., 8*s.* In other respects air parcels for the Rhine Army and Commissions will be subject to the same regulations as similarly addressed parcels sent by ordinary route (*see* pages 78 and 616-7 of the Post Office Guide, July, 1924, edition).

Further particulars of the new service can be obtained on application at any District or Branch Post Office in London, and at any Head Post Office in the Provinces.

An Italian Record

THE Italian pilot Bacola, flying a Savoia seaplane at Sesto Calende, is reported to have attained an altitude of 5,500 m. (18,000 ft.) carrying a load of 249·48 kgs. (550 lb.), which is claimed to be a world's record.

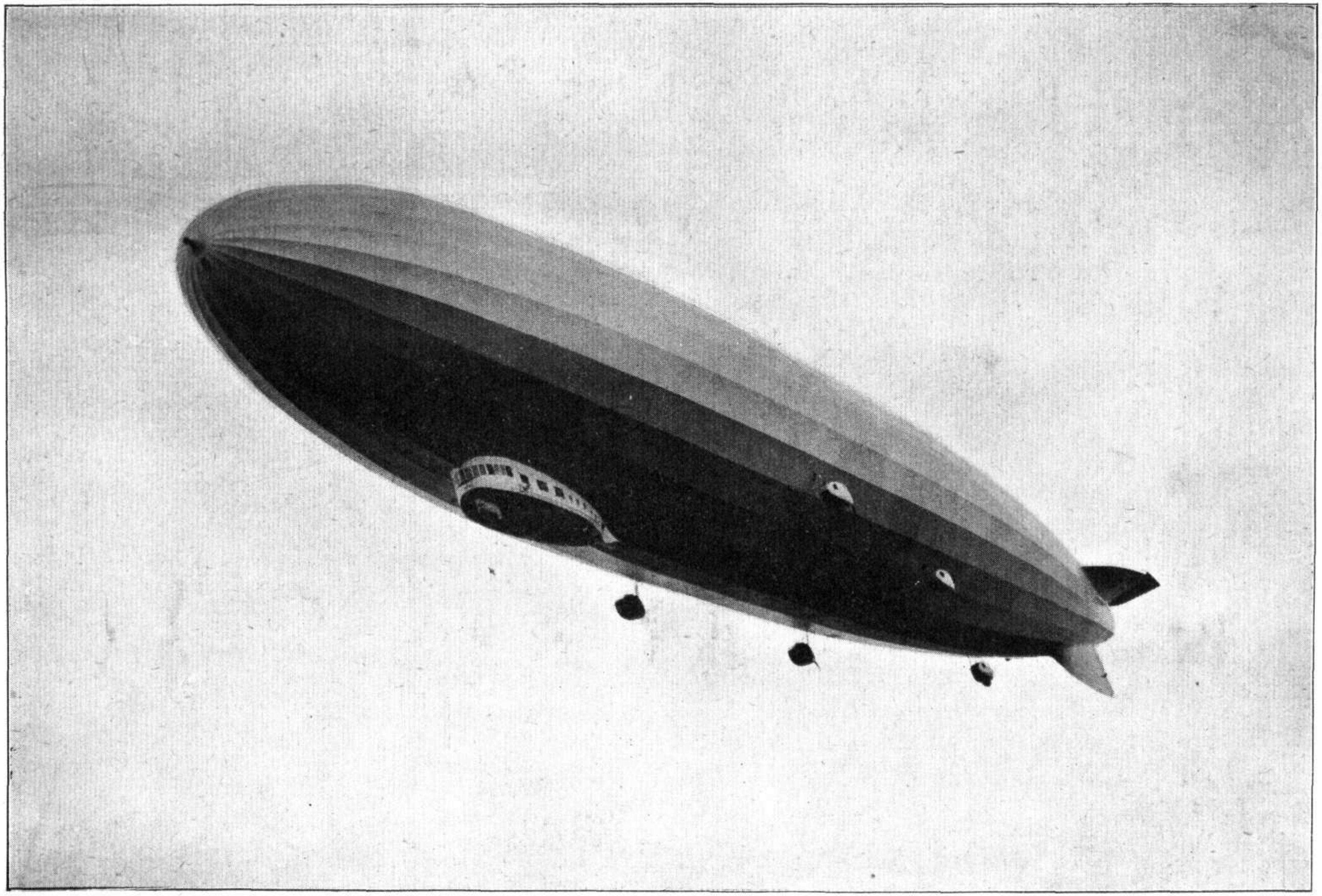


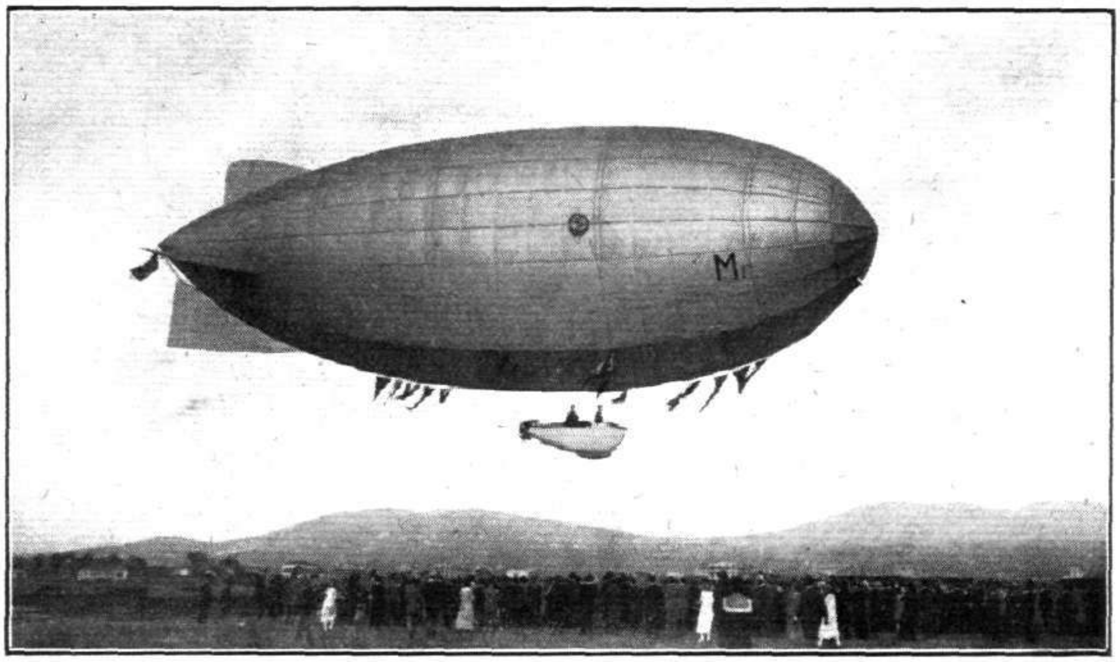
Photo. Daily Mirror Illustrations Bureau

AMERICA'S NEW AIRSHIP : The Z.R.3, which has just been completed at the Friedrichshafen Works of the Zeppelin Company, photographed during a recent test flight over Lake Constance. The distribution of the five engine cars and large main cabin is clearly shown. It will be seen that the nose of the airship is provided with tackle for mast-mooring.

THE ITALIAN SEMI-RIGID AIRSHIP "MR."

The World's Smallest Dirigible

EARLY in June last an interesting ceremony took place in the large airship hangar on the Ciampino aerodrome, Italy, when two semi-rigid airships, the "N.I." (which was fully described in FLIGHT for March 20 last) and the "Mr." designed and built at the Italian Government Airship Construction Establishment, were baptised. His Excellency the Cardinal Prince Granito di Belmonte performed the religious rites before a large and distinguished gathering, Mimi Finzi acting as "Godmother" to the two airships.



The Latest Italian Semi-Rigid Airship: The "Mr." is claimed to be the smallest dirigible in existence. It is only 105 ft. in length, and its capacity is 33,900 cub. ft. With a 40 h.p. engine its speed is about 40 m.p.h.

Photo.: Italian Aeronautical Press Bureau.

One of these airships, the "Mr.," is a new and extremely remarkable type, and we are able to give below some particulars and illustrations of this ship. It is claimed for the "Mr." that it is the smallest airship in the world, but it is mainly remarkable on account of the following facts. Up till now it has generally been asserted that the minimum cubic capacity was possible only in the non-rigid type of airship (and except for a few experimental types, 1,000 cubic metres were considered to be the practical limit), and furthermore it was stated that the semi-rigid type could not successfully be produced below 2,600 cubic metres capacity. As a matter of fact, the Italian Government Airship Construction Establishment disproved this view by the production of the "S.C.A." type of semi-rigid airship (in 1921), designed by Engineer Nobile, which had a capacity of 1,520 cubic metres, whilst at the present time they have done better still with this new dirigible, the effective cubic capacity of which does not reach 1,000 cubic metres.

When it is considered that the percentage of the useful load of an airship diminishes considerably as the capacity is reduced—a limit, of course, being reached when the airship would not be able to lift more than its own weight—the production of so small an airship as the "Mr." is undoubtedly a technical triumph for its designer and constructors. With a capacity of 960 cubic metres the "Mr." has a useful mean load of 450 kgs., or 42·5 per cent. of the total lift, whilst one of the smallest known non-rigid airships (the French Zodiac "Sporting" dirigible) with a capacity of 1,000 cubic metres has a useful load of but 260 kgs., or less than 24 per cent. of the lift. Furthermore, while the maximum speed of this French non-rigid does not exceed 60 k.p.h., the "Mr.'s" speed is 65 k.p.h. —probably a little more.

The successful results obtained with this small airship are particularly noteworthy, in that its new construction, although of an experimental nature, has proved so satisfactory that

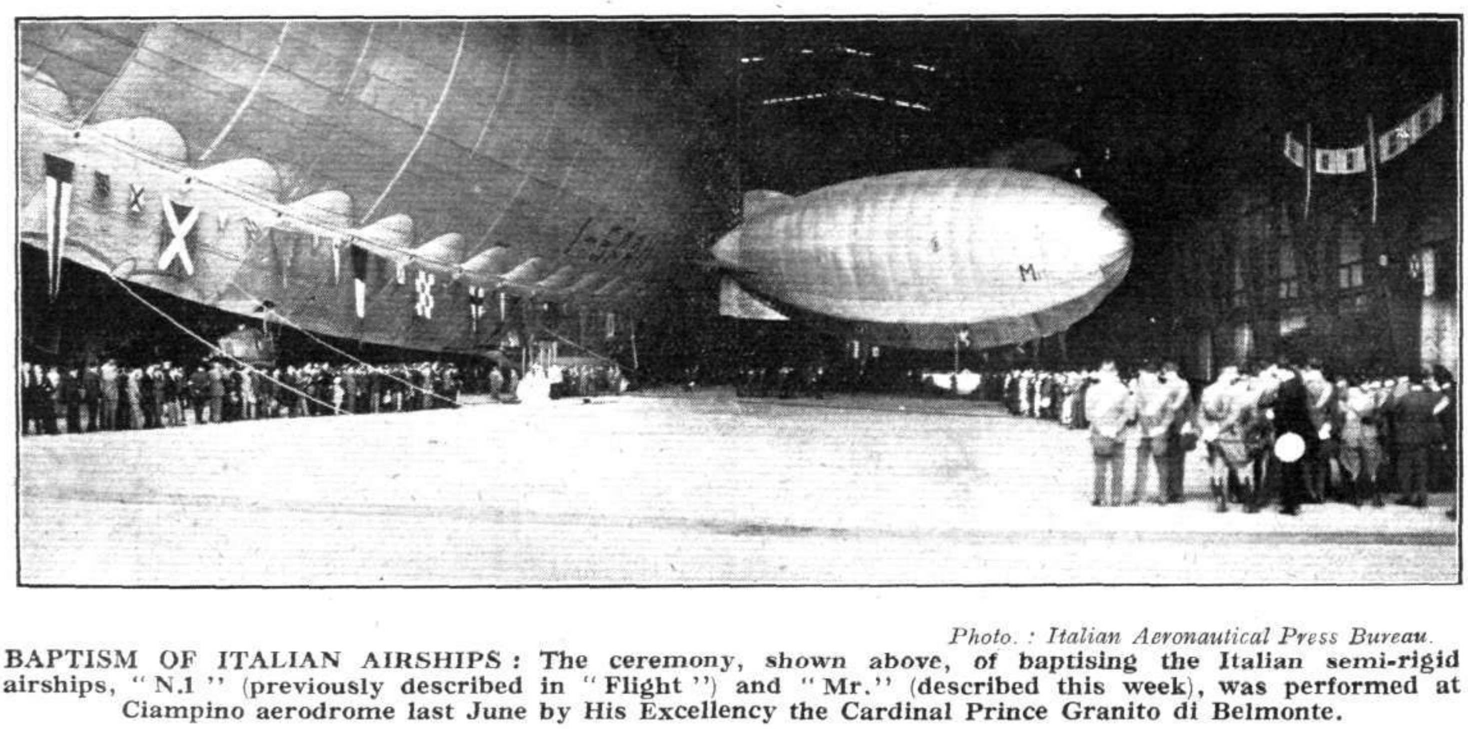


Photo.: Italian Aeronautical Press Bureau.

BAPTISM OF ITALIAN AIRSHIPS: The ceremony, shown above, of baptising the Italian semi-rigid airships, "N.1" (previously described in "Flight") and "Mr." (described this week), was performed at Ciampino aerodrome last June by His Excellency the Cardinal Prince Granito di Belmonte.

several of the structural innovations embodied in its design are to be applied to larger dirigibles, resulting in all probability in some considerable progress in airship design.

The "Mr." was designed by Engineer Nobile, and constructed under his direction in the S.C.A. Factory, with the collaboration of other expert officials: Majors Pesco, Bruno and Biffi, and Captains Vallini and Zezi. Its production was, in a way, an experiment, one of the principal objects of its design being to operate from a base either on land or on board ship from which it can be sent out on scout work within a limited range of action. The exceptional smallness of this dirigible, besides increasing its manœuvrability, in flight, assists considerably in its transporation from base to base—in fact it should be possible to employ an automobile base, in which case the advantages and possibilities obtaining would be considerable.

It may be of interest to note here that the Spanish Navy has already effectively employed two of the S.C.A. type airships during the recent operations in Morocco, employing as base one or other of their ships with every success. In the case of the "Mr." type, inasmuch as its capacity is less than two-thirds that of the types referred to above, such operations should present not the slightest difficulty.

From the structural point of view the new "Mr." presents several important innovations—some of which have not as yet been disclosed. Most of our readers will remember that the fundamental characteristic of the Italian semi-rigid airships consists of the tubular metal keel frame, within the bottom of the envelope, which, while more or less rigid, is given a certain amount of flexibility by means of a series of articulated joints, and is thus capable of adjusting itself to any excessive stresses. In the "Mr." this keel, of triangular form as in the large "N.1" type, is, we understand, absolutely rigid, the flexible joints being absent.

As in previous types, the keel extends from the nose to the stern of the envelope, and from it is suspended a neat boat-shaped car or "gondola." In the stern of the latter is mounted a 40 h.p. air-cooled engine, and it is claimed that it is so placed that a single person can manage the airship. The space within the triangular keel is utilised for the storing of fuel, water and other accessories. The nose of the envelope is reinforced by the naval "umbrella" type nose cap.

The principal characteristics of the "Mr." are: Overall length, 32 m. (105 ft.); diameter, 7·780 m. (25 ft. 6 ins.); capacity, 960 cu. m. (33,900 cu. ft.). As previously stated, the useful load is 450 kg. (992 lbs.), but it is estimated that in the winter season this could be increased to 500 kg. (1,102·5 lbs.). Under such conditions, with one person on board, the "Mr." would have a range of 1,500 kms. (930 miles), or 25 hours' flight, and would attain an altitude of about 3,000 m. (10,000 ft.). In actual practice, however, this duration would be slightly less, as it is doubtful if the type of engine fitted would be capable of such continuous running. The speed is 65 km. p.h. (40 m.p.h.).

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The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

TWO-SEATER LIGHT AEROPLANE COMPETITIONS

Supplementary Regulations, IV

Repairs

SUBJECT to Air Navigation Regulations, a complete engine of the same type and manufacture may be changed, or any engine replacement not specified in the schedule will be permitted, at any time during the Competitions. In either of these cases all previous performances of the machine will be cancelled, and the competitor will be required to start afresh. This will not entail the passing of the Eliminating Tests a second time.

Any changes or replacements as above must be notified in writing to the Clerk of Course. Failure to do so will debar the Competitor from taking further part in the Competitions.

Aeroplane Parts.—Repairs of a minor nature, although they may necessitate the replacement of certain detail parts not scheduled in Supplementary Regulations III, may be allowed with the previous permission of the Stewards.

Closing of the Competitions

The Competitions will close at 2.30 p.m. on Saturday, October 4, 1924.

Offices: THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W.1.
H. E. PERRIN, Secretary

ROUND-THE-WORLD FLIGHTS

IT would seem that the American Round-the-World Flight will be brought to a successful conclusion very soon now, for Lieuts. Lowell Smith and Nelson, the pilots of the two remaining Douglas World-Cruisers, and Lieuts. L. P. Arnold and J. Harding, their observers, have now accomplished the most difficult part of their great adventure. They have, in short, at last reached the American continent, from which they started on March 17 last. True, they still have some 5,000 miles to go before this wonderful World Tour is "officially" completed, but it can safely be said that the worst is now accomplished and the remainder of the journey is plain 'planing.

Having, as reported in last week's FLIGHT, safely reached Greenland, after many weeks' waiting in Iceland, the American World-Flyers gave their machines a thorough overhaul, which they stated was necessary before attempting the 500 mile over-water flight to Labrador—the last of the difficult sections of the route. It was a little over a week before the two machines were ready to resume the journey, and on August 31 they left Ivigtut at about 7.30 a.m. At first there was a slight mist, but the wind was favourable. After a flight lasting 6 hrs. 39 mins., they arrived safely at Icetickle, a small cove on the coast of Labrador, where they were welcomed by a small but enthusiastic crowd, both on land and in various types of boats. The news of their arrival in North America, has naturally caused much rejoicing in the "States," and on September 1 President Coolidge sent the following message of congratulation to the Army airmen:—

"Your history-making flights have been followed with absorbing interest by the people everywhere, and you will be welcomed back to the United States with eagerness and enthusiasm that, I am sure, will compensate you for the hardship you have undergone. Your countrymen are proud of you. Your branch of the Service realises the honour you have won for it. My congratulations and heartiest good wishes to you in this hour of your landing."

Squad.-Ldr. MacLaren, accompanied by Flying-Officer Plenderleith and Serg. Andrews—who made such a plucky attempt at a flight round the world on behalf of Great Britain—left Vancouver, B.C., on August 26 *en route* for England. They hope to meet the American World-Flyers when the latter arrive in Canada, and will thus personally congratulate them.

Major Zanni, who crashed his machine at Hanoi, is awaiting the Fokker seaplane (Napier "Lion"), which has been sent to Hong Kong on the *President Madison*, whence it is being transhipped to the Japanese steamer *Chukwa Maru en route* for Haiphong.

The Second Flight Round Australia

LIEUT.-COL. BRINSMEAD, Director of Civil Aviation in Australia, who, accompanied by Capt. Jones (Superintendent of Flying Operations) and Mr. Buchanan, left Point Cook (Melbourne) in a De Havilland biplane on a flight round Australia, for the purpose of inspecting prospective aerial routes, arrived back in Melbourne at noon on August 29, having covered the 7,550 miles in 22 days. They reached Darwin, Northern Territory, on August 16; Broome, Western Australia, on August 20; and Perth, Western Australia, on August 26.

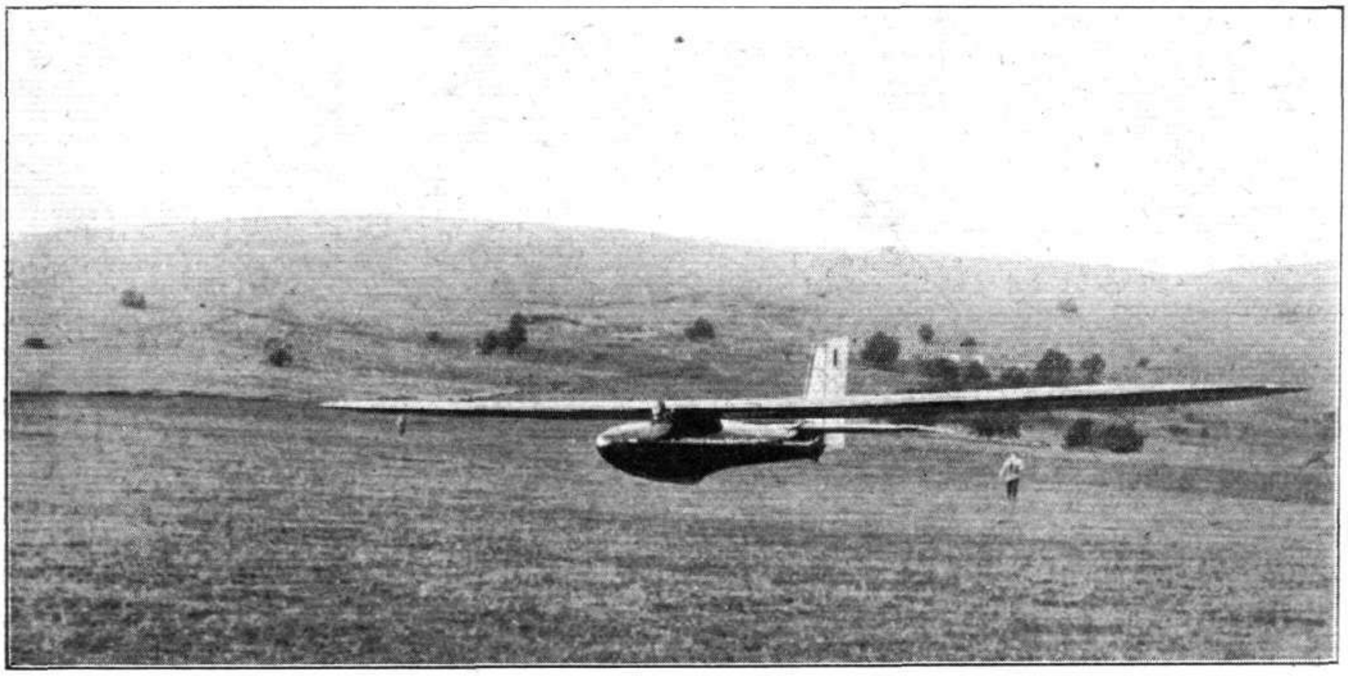
LIGHT 'PLANE AND GLIDER NOTES

Those wishing to get in touch with others interested in matters relating to gliding and the construction of gliders are invited to write to the Editor of FLIGHT, *who will be pleased to publish such communications on this page, in order to bring together those who would like to co-operate, either in forming gliding clubs or in private collaboration.*

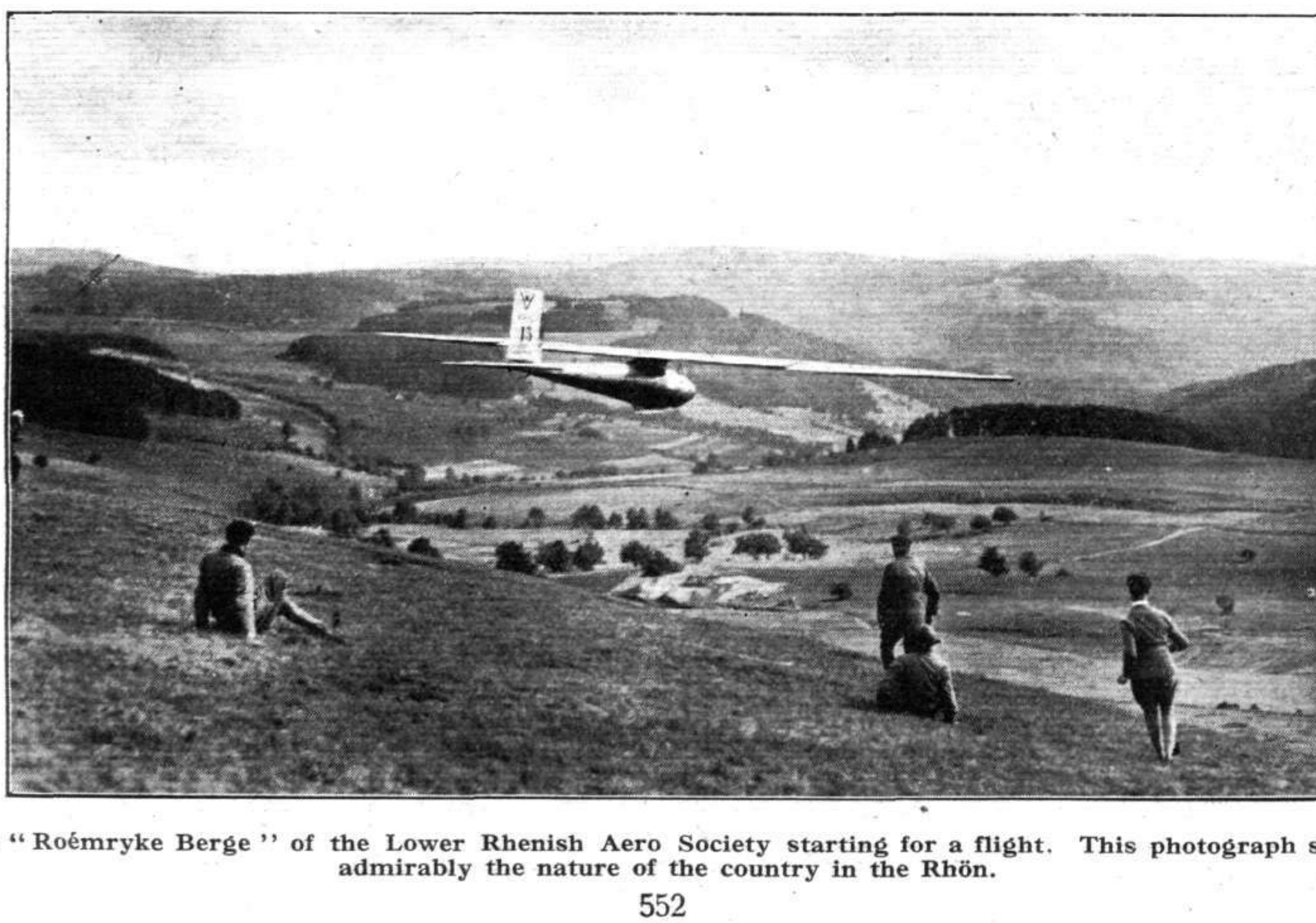
GRADUALLY changes are being made and modifications sanctioned in connection with the forthcoming light 'plane two-seater competitions at Lympne. This week, for instance, Supplementary Regulations IV, published under the Official Notices of the Royal Aero Club, under whose competition rules the trials are being held, state that it has been decided that complete engines may be changed, provided the engine taken out of a machine is replaced by one of the same make and type. Also such engine parts as are not specified in the schedule may be changed. But the penalty of so doing is that all previous performances of the machine are cancelled, and the competitor must start afresh.

* * *

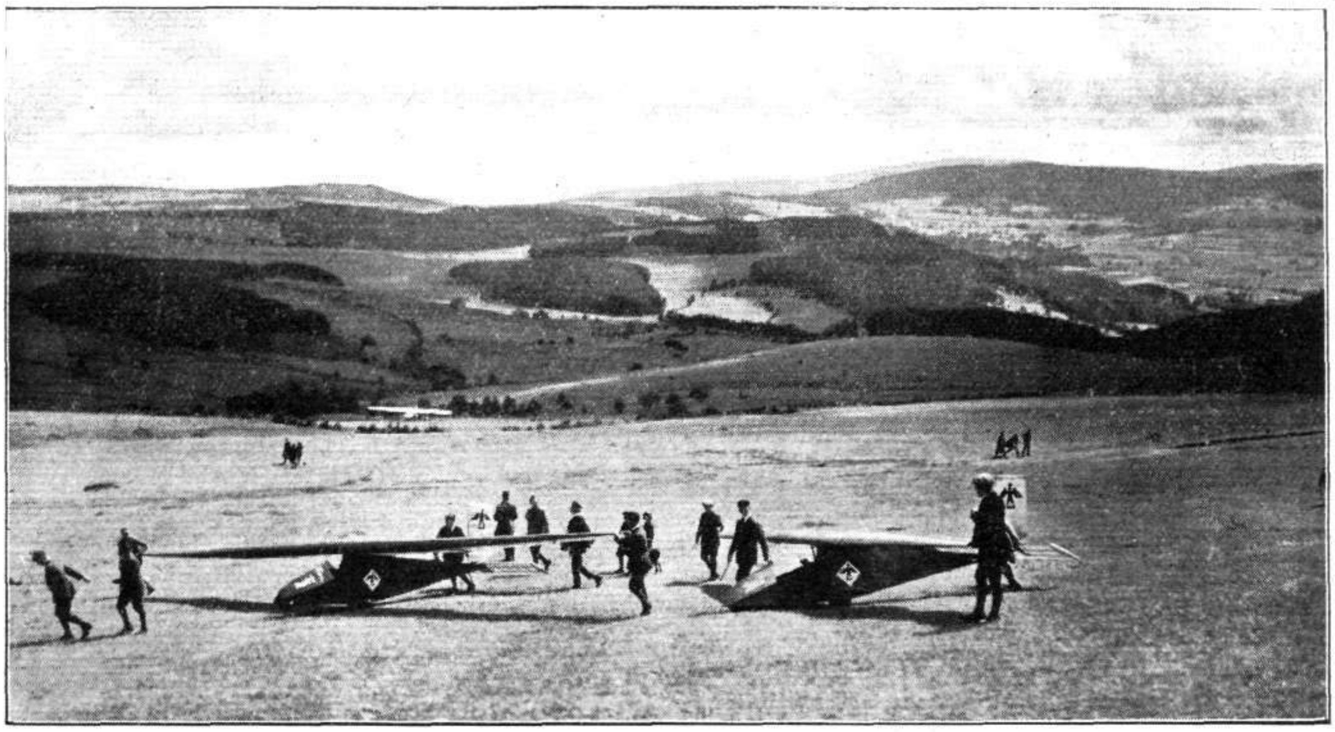
THE position now is, apparently, that the engine parts which may be changed without penalty are: Carburettors and parts of carburettors; propellers of the same design, construction and dimensions; sparking plugs; valves and springs; and magnetos. The complete engine, and any



FROM THE RHÖN MEETING: The Darmstadt "Konsul" making a landing on a predetermined spot. It was on this machine that Botsch flew 19 kilometres last year. Note the extremely high aspect ratio.



The "Roëmryke Berge" of the Lower Rhenish Aero Society starting for a flight. This photograph shows admirably the nature of the country in the Rhön.



FROM THE RHÖN MEETING: Two of Arthur Martens' machines, the "Moritz" and the "Strolch." Both are very reminiscent of the famous "Vampyr."

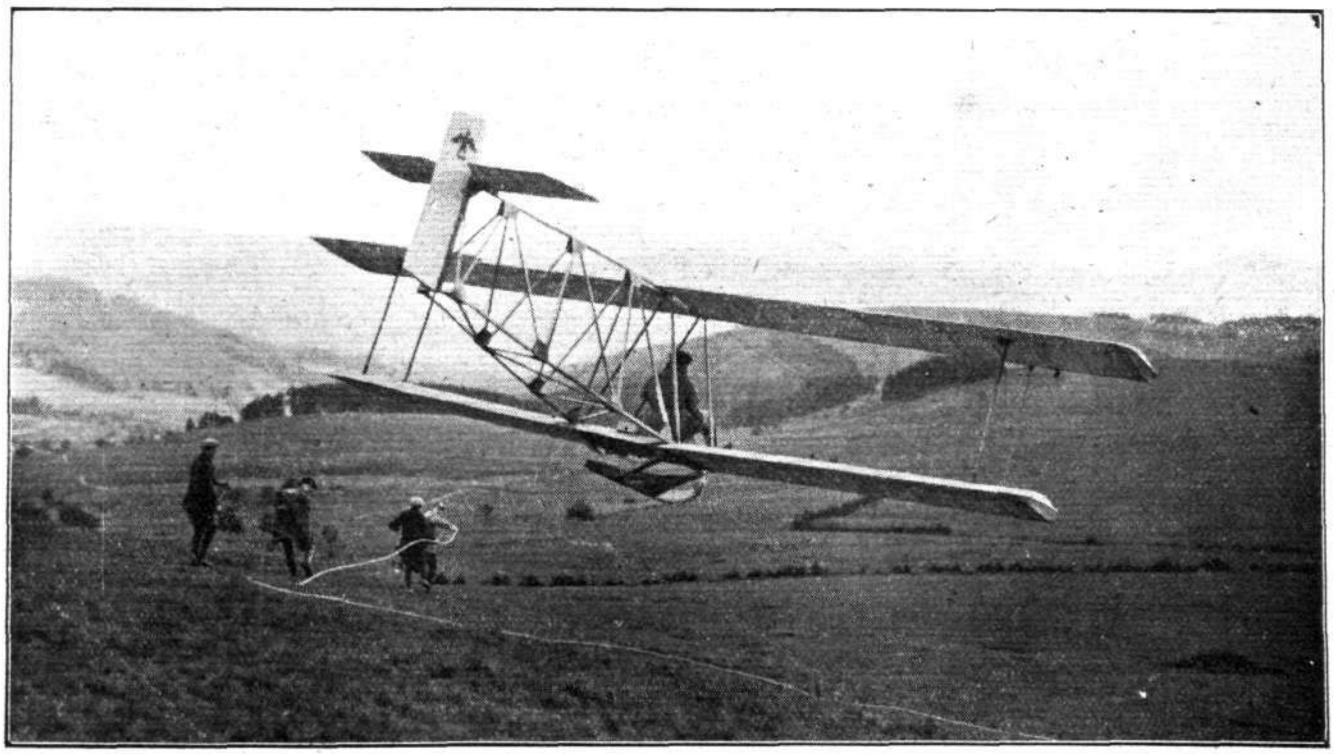
parts not specified in above list, may be changed, but if this is done a fresh start must be made. This does not, however, include the eliminating trials.

* * *

THAT the competitions will be extremely hard on the engines cannot be denied. In the first place, it seems likely that each competitor will make at least two attempts on the high-speed test. This means flying 300 miles with the engine running "all-out," and is in itself a very searching test. Then there are low-speed tests, getting-off tests, alighting tests and such like. In addition to these, the machines will have to do a good deal of flying during the week in order to bring the total up to 10 hours' flying. So that, one way and another, the engines will certainly not have an easy time of it. The decision to allow competitors to change engines will help to a certain extent, inasmuch as a competitor, who might by sheer bad luck suffer damage to an engine part fairly early in the trials, will be allowed to start afresh and will not be put *hors de combat* for the rest of the week. It is conceivable that in this manner a good deal of disappointment may be avoided.

* * *

FROM the concessions made in the matter of engines it is, perhaps, permissible to hope that on the subject of the slow-flying tests those responsible for drafting the regulations will sanction further alterations from the original rules, and will permit these tests to be flown at a less dangerous height than the 20 ft. stipulated at present. Last week we pointed out



A SCHOOL MACHINE AT RHÖN: A pupil starting on his first flight in a Martens School biplane. Note the simple and robust construction.

the risks which slow flying at this height entails, and it is to be hoped that the matter may be reconsidered and a greater altitude be permitted.

* * *

SOME time ago we referred to the apparently ridiculous fee charged by the Air Ministry for a "certificate of exemption." It now seems that we were rather less than fair to the Air Ministry on this subject, and that our information was somewhat incomplete. The position actually appears to be this: The certificate of exemption, for which a fee of £12 10*s*. is made, virtually amounts to a certificate of airworthiness for the machine but not for the engine. Thus if, at a later date, a constructor who has obtained the certificate of exemption should instal an engine which has been given its airworthiness certificate, the machine automatically becomes an airworthy machine, and the certificate of exemption is then regarded as the equivalent of the usual certificate of airworthiness. Viewed in this light, the apparently absurd fee becomes quite reasonable. We trust that the position has now been made clear, especially as, whatever criticisms we feel it necessary to make, we have no desire to be other than fair to the Air Ministry.

* * *

MR. J. W. HOLMES, of 14, Oswin Avenue, Bally, Doncaster, writes to say that he will be pleased to hear from fellow readers of FLIGHT in the Sheffield and Doncaster districts who are interested in the formation of a club of a technical nature for the study and practice of aviation, particularly bearing in mind the new Air Ministry scheme for the formation of light 'plane clubs.

* * *

M. LOUIS PEYRET, of Itford fame, has recently designed and built a light seaplane biplane for M. Yves le Prieur, with the object of using the machine for school work. A slow machine was wanted, and the Peyret biplane, with a Schoukovsky wing section and a wing loading of less than 2 lbs./sq. ft., was expected to meet the requirements. A 16 h.p. Sergant was fitted, but on the first trials it was discovered that this did not give enough power to enable the machine to get over the "hump speed." A 45 h.p. Anzani was then fitted instead, and with this the Peyret biplane is stated to have got off easily. It appeared that for getting "unstuck" about 25 h.p. is necessary, while once the machine is in the air it flies on approximately 15-20 h.p. It will be recollected that Mr. W. O. Manning, in a paper read before the Institute of Aeronautical Engineers, called attention to the possibilities of the light seaplane, and it is of interest to note that the usual very low power of a light 'plane is likely to be insufficient for seaplane work. By proper development of hull shapes, etc., it is, however, conceivable that a really low-power machine might be evolved.

* * *

THE famous French aeroplane and glider pilot, Lieut. Thoret, has succeeded in raising the "world's duration record" to 9 hours 4 minutes. He was, however, flying an engined aeroplane with propeller stopped, and so his performance will not be officially recognised. The scene of the flight *hélice calée* was at Saint-Rémy-de-Provence.

* * *

IT seems that the "summer" of 1924 will go down in history as one of the worst in the annals of flying. It is evidently not only in this country, but quite as much on the Continent that weather conditions have been extremely bad for flying, and one result has been that the Rhön meeting has been somewhat of a failure. This is all the more regrettable in view of the large numbers of machines entered, light 'planes as well as pure gliders. With the latter comparatively little has been done this year, owing entirely to the bad weather. The light 'plane trials also have suffered, but, at any rate, one race has been held, from the Wasserkuppe to Kissingen, a distance of approximately 20 miles.

* * *

SUNDAY, August 24, had been set aside for this race, but the weather was extremely bad, with rain and fogs. Ultimately, however, it cleared up a little, and it was decided to make a start. Only three machines were ready for the start—the Udet "Kolibri" with Douglas engine, piloted by Herr Udet himself; the Blume-Hentzen "Habicht," piloted by Herr Blume, and the "Strolch," flown by Herr Arthur Martens. No. 74, the Baumer monoplane with 350 c.c. Douglas, developed engine trouble and was unable to get away.

* * *

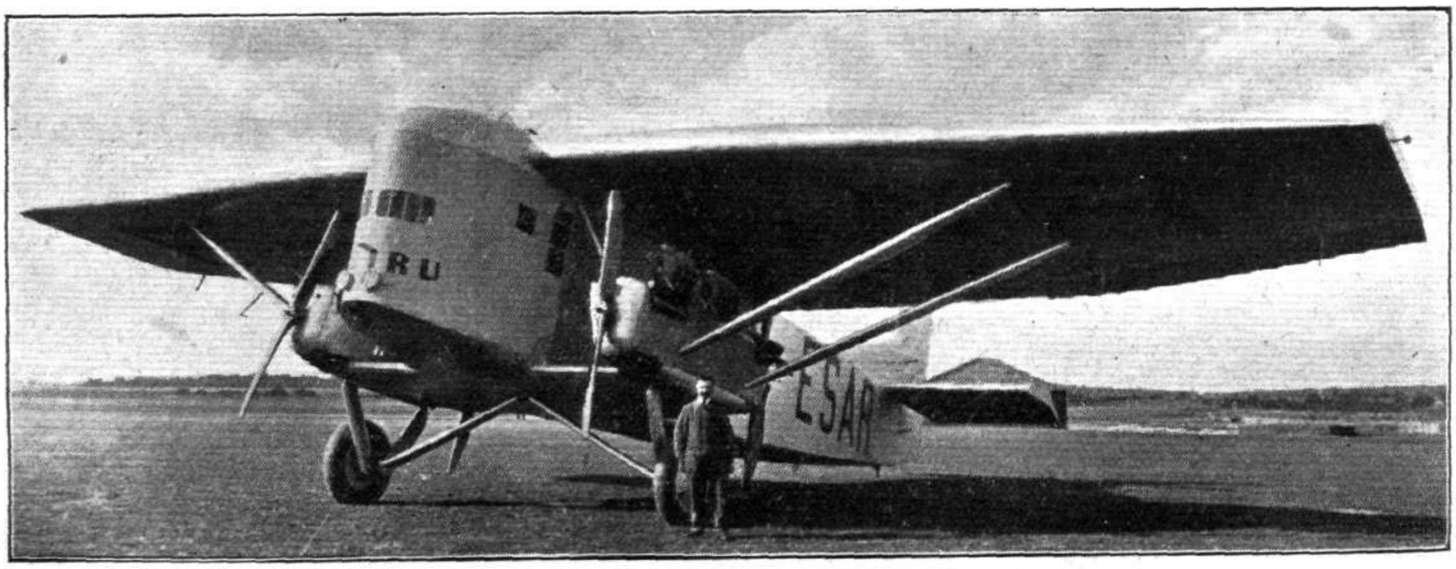
HERR UDET was the first to reach Kissingen, having covered the distance of 20 miles in 22 minutes. He was followed four minutes later by Herr Martens, and finally Herr Blume arrived, 22 seconds after Martens. The aerodrome at Kissingen was soft owing to the rains, and the competitors had difficulty in getting off again. Herr Martens had to abandon the attempt, while Herr Blume on "Habicht" had engine trouble and came down at Bischofsheim. Herr Udet succeeded in reaching the Wasserkuppe, but the hill was surrounded by fog and he had great difficulty in landing. Ultimately, however, he made a safe landing, having taken 36 minutes for the return journey from Kissingen. During the day the "Margarete" glider (illustrated last week) put up a new "record" by remaining aloft for 21 minutes carrying pilot and passenger.

Bristols for Afghanistan

Two Bristol Fighters have recently been delivered to the Ameer of Afghanistan at Kabul. After demonstration flights had been made, the War Minister, Abdul Aziz, and the Foreign Minister, Sher Mahomed, were taken up for flights. The British pilots who were in charge of the machines were later decorated by the Ameer with gold medals, the mechanics receiving silver medals.

London-Copenhagen Air Service

ON September 1 a new air service was inaugurated between London and Copenhagen. This service is a daily one, Imperial Airways, Ltd., operating the section between Croydon and Amsterdam. The section between Amsterdam and Stettin is operated by German machines, the rest of the journey being carried out by seaplanes. The total flying time for the journey is about 11½ hours.



The Farman "Jabiru," four Hispano-Suiza engines, which won this year's Grand Prix for commercial aeroplanes.

NOTES ON GEOMETRICAL SIMILARITY IN AIRPLANES*

By EDWARD P. WARNER

THE growing popularity of the light 'plane, and the repeated suggestions that it may prove a satisfactory vehicle for making preliminary tests from which the performance of much larger airplanes can be predicted, make it desirable that an investigation of the relation between large and small airplanes of geometrically similar form be undertaken. Already one prominent French airplane constructor has built a machine of but little above the light 'plane class as a scale model of a giant airplane which he has projected, and the construction of the large airplane will presumably be governed to some extent by the lessons learned during the trials of the small one. There can be no doubt, if this project of making man-carrying scale models proves a practicable one, that it will be very widely taken up.

Instead of seeking to establish perfectly general relations between the performances of a large airplane and a small one, it seems desirable rather to determine the ratios which should exist between certain geometrical characteristics in order that the performances may stand in some particular desired relation. The elements of performance, including all the flying qualities of the airplane within that term, are measurable in terms of length, time and angle, as fundamental quantities, those quantities appearing either singly or in combination. Obviously, those elements of performance measured in terms of angle, such as the inclination of the climbing path, should be independent of the size of the airplane, while those measured in length, such as the minimum radius of turn, should be directly proportional to the linear dimension. The question of the variation of those elements into which time enters may be put aside for the moment, except for mention of the obvious fact that the linear velocities must be proportional to the product of angular velocities and linear dimension.

The various elements of performance and the characteristics of the airplane will now be taken up and investigated one by one. It would, of course, be possible to rely on the general theory of dimensions in deriving the desired relations, but conclusions can be extended over a somewhat broader range if each feature of performance is analysed separately by methods simpler, and in some cases less rigorous, than the general theory.

Minimum Radius of Turn.

Centripetal force in turning is proportional to the product of weight, angular velocity and linear velocity. If airplanes of different size are to turn at the same angle of bank and with the same control setting the ratio between centripetal force and weight must obviously be constant, and the product of angular and linear velocities must therefore be independent of linear dimension. The square of the speed must then be proportional to the radius of the turn for a given condition of flight. Since the radius is a distance, it should vary as the first power of a dimension of the airplane, if strict similarity of performance is maintained, and the speed must therefore be proportional to the square root of such a dimension of the airplane. It follows also that the angular velocity is inversely proportional to the square root of a linear dimension. Since the loading of the wings varies directly as the square of the speed for a given angle of attack, $\frac{W}{S}$ must be proportional to the first power of a dimension of the airplane, and the total weight must vary as the cube of such a dimension. For similarity of performance there is then the same rule of variation of weight as for strictly geometrically similar structures.

If this relation of weight and size be followed, not only the minimum radius of turn, but also the radius for any specified set of conditions will be proportional to the first power of a length in the airplane. For any fixed angle of attack and angle of bank the ratio of turning radius to wing span will be independent of size.

Controllability in Turning

The maximum angular velocity of an airplane is sometimes fixed by the power of the control to overcome the damping of the rotation, rather than by a simple balancing of centripetal force and horizontal component of lift. Damping moments are proportional to the product of an angular velocity, a linear velocity, and the fourth power of a linear dimension, while control moments vary as the cube of a length and the square of a linear speed. In order that controlling power may enter in as a limitation in the same way for a whole series of geometrically similar airplanes, it is therefore sufficient that $l^3V^2 = l^4V\omega$, or that $V = \omega l$. Obviously, any relation between speed and size which will make radius of turn proportional to length of airplane will also satisfy this equation. The constant ratio between radius and length will therefore hold good, no matter what the factor principally limiting radius may be.

Angular Acceleration

The angular acceleration of an airplane for a given control setting is, of course, proportional to the ratio of controlling moment to moment of inertia. The first of these quantities varies as the cube of a linear dimension and the square of a speed, the second as the product of the weight and the square of a length, and the ratio is therefore proportional to $\frac{V^2l}{W}$. If the relation, already derived, between l, V, and W be complied with, this varies inversely as a length. The time required to reach a specified velocity at constant angular acceleration would therefore be proportional to the linear dimension of the airplane, but, since the maximum angular velocity itself varies inversely as the square root of a length, the time required to reach the maximum is proportional only to $\sqrt{l}$. Distance being the product of time and speed, the distance covered in reaching maximum angular velocity or any particular fraction of the maximum must be directly proportional to l, and the angle through which the airplane turns from the beginning of a manœuvre until a particular proportion of the maximum attainable angular velocity has been arrived at is quite independent of dimension. This, again, is as it should be.

Dynamic Stability

While on the subject of control and manœuvring power, attention may be given also to the equations determining the amplitude and period of the oscillations of an airplane. The work need not be followed in detail, but if the variation of each of the resistance and rotary derivatives be examined separately, it is found that the coefficients in the familiar stability equation:

$$A\lambda^4 + B\lambda^3 + C\lambda^2 + D\lambda + E = 0$$

vary with l in a descending scale of powers of $l^{1/2}$, the first coefficient varying as l^2. This is obviously equivalent in effect on any solution of the equation to a variation of λ, the logarithmic determinant itself, in the ratio of the inverse square root of l. Since the amplitude of an oscillation at any time subsequent to its beginning is equal to $Ce^{\lambda t}$, the time required to damp or increase the amplitude of oscillation by a definite ratio must, obviously, be proportional to $\sqrt{l}$, if λ varies as the inverse square root. V and t then change with l in the same way, while the distance required to damp an oscillation by a specified amount or to complete one period of an oscillation is proportional to the product of V and t, or to a linear dimension of the airplane. Thus, once again, two lengths vary in the same ratio.

Minimum Speed

The minimum speed, being proportional to the square root of the wing loading, evidently varies as $\sqrt{l}$. The kinetic energy possessed by the airplane on coming in contact with the ground then varies as l^4, and, assuming the coefficient of friction the same in all cases, the landing run during which friction and air resistance dissipate this kinetic energy varies directly as a linear dimension of the airplane.

Maximum Speed

Obviously, in order that performances may be comparable, geometrically similar airplanes should fly at maximum speed at the same angle of attack. The maximum speeds must therefore vary in the same ratio as the minima. At a given angle of attack the power required for flight is proportional to the product of the area and the cube of the speed. If the speed varies as $\sqrt{l}$, and the propeller efficiency is constant, the power must then be proportional to $l^{7/2}$. To satisfy maximum speed requirements in a series of geometrically similar airplanes the engine power must therefore vary somewhat more rapidly than the weight.

* Part 2 of American N.A.C.A. Technical Note, No. 190. Part 1 is a mathematical Analysis, by Max M. Munk.

Propeller Efficiency

In order that propeller efficiency may be constant, the slip function $\frac{V}{ND}$ must be held at a constant value. If V varies as $l^{1/2}$, N must therefore be inversely proportional to $\sqrt{l}$. This condition satisfies the equation of propeller power absorption also. Since the power consumed by a propeller at a constant value of the slip function is proportional to N^3D^5, it will vary as $l^{7/2}$, if N changes with size in the manner just stated.

Speed and Angle of Climb

The ratio between the powers required for flight at two particular angles of attack is obviously independent of airplane size. If the maximum speed corresponds to the same angle of attack in every case and the propeller characteristics are in accordance with the relation just derived, the percentage of reserve power at the angle of best climb will then be the same for a whole series of geometrically similar airplanes. Dividing reserve power by weight it appears that climbing speed varies as $l^{1/2}$, or, in the same ratio as speed of flight. The climbing angle is therefore the same in all cases.

Linear Acceleration

The linear acceleration of an airplane in taking off is proportional to the ratio of thrust to weight, and that is obviously constant, if the prescribed relation between power and other characteristics of the airplane be preserved. The distance travelled in acquiring a given velocity is then proportional to the square of this velocity, and that, in turn, is proportional to l.

It has now been seen that all of the flying qualities of a small airplane can be made directly comparable with those of a large one, if a very simple relation between size, weight, power, and R.P.M. is maintained. That could have been predicted from the general theory of dimensions, following the line of Dr. Munk's work, and, indeed, the relations derived are identical with those given by Froude's law of comparison, and used for ships.* There are some points, however, at which similarity of performance breaks down. As pointed out by Dr. Munk, the condition of aerodynamic similitude, which would make the speed inversely proportional to a linear dimension, cannot be maintained, and the relation existing between flying characteristics in large and small sizes will also be modified by any structure in the atmosphere, a structure which will necessarily have linear dimensions of its own. Either periodic gusts or regions of turbulence will have effects depending largely on the size of the airplane which meets them. It is therefore somewhat unsafe to attempt to predict the behaviour of a giant airplane in rough air from tests on a miniature prototype, but there need be no hesitancy about the application of data thus obtained on performance and on manœuvrability under good conditions. The variation of the Reynolds number is unlikely to have any serious effect after values even as large as those for the smallest of light planes have been reached.

STRUCTURAL RELATIONS

The fact that it has been found necessary to vary the weight as the cube of a linear dimension suggests the possibility of building the structures in strict geometrical similarity, in order that the percentage of weight allotted to each part may remain the same in all cases. That would, indeed, be highly desirable for complete similarity of performance, as the radii of gyration are hardly likely to vary in the same manner as the overall dimensions, unless all the internal structure is kept of similar form as size is changed.

It is, of course, impossible to hold rigidly to similarity of structure. The thickness of fabric, for example, can hardly be decreased in proportion to the wing span, and the type of joint used in built-up members of large airplanes can hardly be duplicated in small ones. To a certain point, however, similarity can be maintained if it proves to be structurally safe to hold to it.

Considering first those members which are loaded directly in tension or compression, it is obvious that their strength is proportional to l^2. This is true even of long struts, since the ratio of l to k will be independent of the size of the airplane. The load carried by such members is proportional to the airplane weight, and the factor of safety in them therefore varies inversely as a linear dimension. Over the range of sizes now used, this is just about the desirable rate of variation, as it will be found that the load factors now specified for a high angle of attack are given approximately for all classes of military airplanes by the formula : $F = \frac{320}{b}$, where b is the wing span.

A similar relation holds true for beams. The bending moment varies as the weight of the airplane times the span, or as the fourth power of a linear dimension, while the section modulus is proportional to l^3. The factor of safety at a given load factor again changes inversely with l. When the beam is subject to buckling, however, the relation is no longer simple. The column effect is approximately allowed for by Perry's formula : $M^1 = M \times \frac{P_e}{P_e - P}$, where M is the bending moment due to lateral load, M^1 the bending moment corrected for buckling, P the compressive load, and P_e the load which would produce failure by lateral collapse if there were no lateral load at all. P is proportional to l^2, P_e to l^3, and the corrected bending moment under unit load therefore changes with linear dimension in an irregular fashion. If, however, the load factor assumed to act itself varies as the inverse first power of l, P_e and P will change at the same rate and the column effect will remain always of the same relative importance.

It is also of interest at times to know the deflection of the parts of an airplane. The flexural deflection of the wing spars, being proportional to $\frac{Wl^3}{EI}$, will vary as l^2, if the spars are made in the same way and of the same material. Deflections of the wing truss due to the direct elongation and compression of the members also follow the same law, since the unit stress under a given load factor has been shown to be proportional to l and the total change of length of each member must therefore be in the ratio of l^2. If, however, the highest load factors actually imposed are in the ratio of $\frac{1}{l}$ the structures will deflect in a geometrically similar manner.

Deflection is perhaps most serious in its effect on the performance of the propeller, the angle of twist of the propeller blade being proportional to l in geometrically similar airplanes. A type of propeller suitable for a small airplane might, therefore, be quite unsatisfactory on a large one of the same design, even though its calculated strength were sufficient, and tests on geometrically similar airplanes should be carried out with propellers so designed as to have a minimum of torsion.

Illustrative Example

To show how all of this work can be applied in practice, an airplane similar in general characteristics to the "Barling bomber," having a total weight of 42,000 lbs., a span of 130 ft., an area of 4,200 sq. ft., and powered with six 400 h.p. engines, may be used as an example. Models of one-third, one-fourth, and one-fifth full size have been calculated, and their characteristics are tabulated below :—

Span. Ft.	Area. Sq. Ft.	Weight. Lbs.	Total Horse-Power.	R.P.M.
43	467	1,560	52	2,950
32	262	660	19	3,400
26	168	340	8·5	3,800

Obviously, the third case is impossible to realise, as the pilot's weight would be more than half of the total carried in flight, and the six engines of 1½ h.p. each would make up most of the remainder. The second case might be barely possible with 3 h.p. engines specially built for the purpose. The weight available for structure would be about 300 lbs., the area being 260 sq. ft., and the wing loading 2·5 lbs. per square foot. The first case would be easy to realise.

With everything considered, and the advantage and drawbacks of the light 'plane as a flying model balanced against each other, it still seems quite possible that the construction of such flying models would be well worth while in some cases, particularly if the development of large airplanes of eccentric form and arrangement is to continue, and the practice initiated by the French constructor, already referred to, may on occasion prove a profitable one elsewhere.

* "Speed and Power of Ships," by D. W. Taylor, p. 26.

Czecho-Slovak Military Flight

FOUR military S. 6 aeroplanes of the Czecho-Slovak Air Service are making an aerial tour, starting from Prague, of the countries of the Little Entente, including Bratislava (Pressburg), Agram, and Novy Sad, when they will visit the Jugo-Slavian Air Force.

THE ROYAL AIR FORCE

London Gazette, August 26, 1924

General Duties Branch

The following Cadets having successfully passed through the R.A.F. (Cadet) College, are granted permanent commns. as Pilot Officers, with effect from, and with seny. of, July 31 :—J. H. McC. Reynolds, D. A. Boyle, A. W. Elias, J. E. W. Bowles, R. Ll. R. Atcherley, W. O. Du Port, H. R. D. Waghorn, G. N. J. Stanley-Turner, J. T. Eve, J. Warburton, A. B. Kay, C. S. M. Woode, J. A. T. Ryde, H. H. Brookes, R. H. Barlow, J. C. Don, F. M. Denny, L. R. W. Tillard, F. W. M. Matthews.

The following Pilot Officers are promoted to rank of Flying Officers ; June 20 :—R. B. Jordan, F. E. Nuttall.

The following Pilot Officers on probation are confirmed in rank :—E. A. C. Bushell, E. R. H. Coombes, J. C. Hill, A. C. C. Mason, V. A. C. Ross, P. Stainer, H. St. George-Taylor ; May 10. R. W. E. Bryant, S. E. Bulloch, J. E. Clayton, R. K. Coupland, P. Cranswick, M.C., H. T. R. Cripps, E. H. Fielden, T. H. Finney, G. D. Green, P. P. Grey, A. F. Hutton, G. W. P. Irwin, G. H. Jennings-Bramly, J. C. Marcy, F. W. Moxham, J. F. Nicholas, D. Robinson, G. W. R. Russell, A. E. P. Snith, V. W. Soltau, C. F. Steventon, J. Summers, W. A. Tattersall, F. F. Wilkinson, J. F. Young ; July 14.

Flying Officer W. M. Shoosmith is transferred to the Reserve, Class A ; Aug. 23.

The following Pilot Officers resign their short service commns. (Aug. 27) : D. J. Dorey, J. K. Trimmer. Pilot Officer R. G. Rickman relinquishes his short service comm. on account of ill-health ; Aug. 27.

ROYAL AIR FORCE INTELLIGENCE

The following appointments in the Royal Air Force are notified :—

General Duties Branch

Wing Commander C. C. Miles, M.C., to R.A.F. Depot, whilst attending War Staff Course at R.N. College, Greenwich ; 15.9.24.

Squadron Leaders : L. C. Keeble, F. E. Hellyer, O.B.E., and R. C. Hardstaff, all posted to Inland Area Aircraft Depot, Henlow ; 15.9.24. R. B. Maycock, O.B.E., to R.A.F. Depot ; 15.9.24. D. E. Stodart, D.S.O., D.F.C., and A. F. A. Hooper, O.B.E., to R.A.F. Depot ; 1.9.24. G. W. Williamson, O.B.E., M.C., to No. 1 Flying Training Sch., Netheravon, on tranfer to Home Estab. ; 1.9.24.

Flight Lieutenants : P. G. Scott, C. B. Dalison, A.F.C., L. J. MacLean, M.C., R. T. B. Houghton, A.F.C., L. M. Iles, A.F.C., H. L. Macro, D.F.C., A.F.C., C. E. Maitland, D.F.C., J. D. Breakey, D.F.C., J. R. Bell, D.F.C., all posted to Inland Area Aircraft Depot, Henlow ; 15.9.24. J. A. Barron, to Inland Area Aircraft Depot, Henlow ; 1.9.24. T. A. Warne-Browne, D.S.C., to No. 5 Flying Training Sch., Sealand ; 1.9.24. C. F. le P. Trench, to No. 1 Sch. of Techn. Training (Boys), Halton ; 1.9.24. K. A. Meek, M.B.E., to Mech. Transport Repair Depot, Shrewsbury ; 1.9.24. W. Helmore and W. G. Meggitt, M.C., to R.A.F. Depot ; 1.9.24. C. Pilkington, A.F.C., to No. 13 Sqdn., Andover , 14.8.24. W. E. G. Mann, D.F.C., to No. 56 Sqdn., Biggin Hill ; 3.9.24.

Flying Officers : J. M. Glaisher, D.F.C., T. C. Traill, D.F.C., J. Duncan, C. T. Walkington, H. W. Heslop, C. P. M. B. Caillard, G. W. Birkinshaw, R. A. Whyte, F. W. Sinclair, D.F.C., and M. S. Keogh, A.M., all posted to Inland Area Aircraft Depot, Henlow ; 15.9.24. R. H. Stewart Peter (Hon. Flt.-Lieut.), to No. 39 Sqdn., Spittlegate ; 1.9.24. H. O. Brown, M.M., and C. H. Harrison, to R.A.F. Depot ; 1.9.24. V. P. Feather, to Elec. and Wireless Sch., Flowerdown ; 1.9.24. J. F. Titmas to No. 4 Stores Depot, Ruislip ; 1.9.24. R. Jones, to No. 56 Sqdn., Biggin Hill ; 1.9.24. J. T. O'Brien-Saint, to No. 13 Sqdn., Andover ; 1.9.24. E. D. H. Davies, to No. 1 Sch. of Tech. Training (Boys), Halton ; 1.9.24. A. C. Meredith, to R.A.F., Base, Gosport ; 1.9.24. R. B. Jordan, to R.A.F. Base, Calshot ; 6.8.24. F. J. Phillips, to No. 13 Sqdn., Andover ; 15.8.24. H. G. P. Ovenden, to remain at Elec. and Wireless Sch., Flowerdown, instead of to No. 207 Sqdn., as previously notified. H. L. Christie to R.A.F. Depot on transfer to Home Estab. ; 12.8.24. H. L. Christie, to No. 1 Sch. of Tech. Training (Boys), Halton ; 24.9.24. O. V. Lee, to No. 13 Sqdn., Andover, ; 14.8.24. G. Lansdowne, D.F.C., to Sch. of Naval Co-operation, Lee-on-Solent ; 15.9.24. A. B. Cree, to School of Army Co-operation, Old Sarum ; 9.9.24.

THE H. G. HAWKER ENGINEERING CO.'S SPORTS DAY

Despite the attentions of our all-too-familiar friend Jupiter Pluvius, the Hawker Sports Day at Kingston on August 23 was a great success, and the large crowd who braved the elements were amply rewarded by the splendid racing and competitions. Great keenness was shown in the inter-departmental competitions, particularly in the tug-of war event, and in the relay race for the Sopwith and Sigrist Challenge Cups respectively. The fitting department, after a hard contest, won the tug-of-war event, defeating the machine shop by two pulls to one, but the tables were turned in the relay race, the machine shop running in fine style. Some good times were recorded, and in the high jump J. Ross cleared 5 ft. 7½ ins.

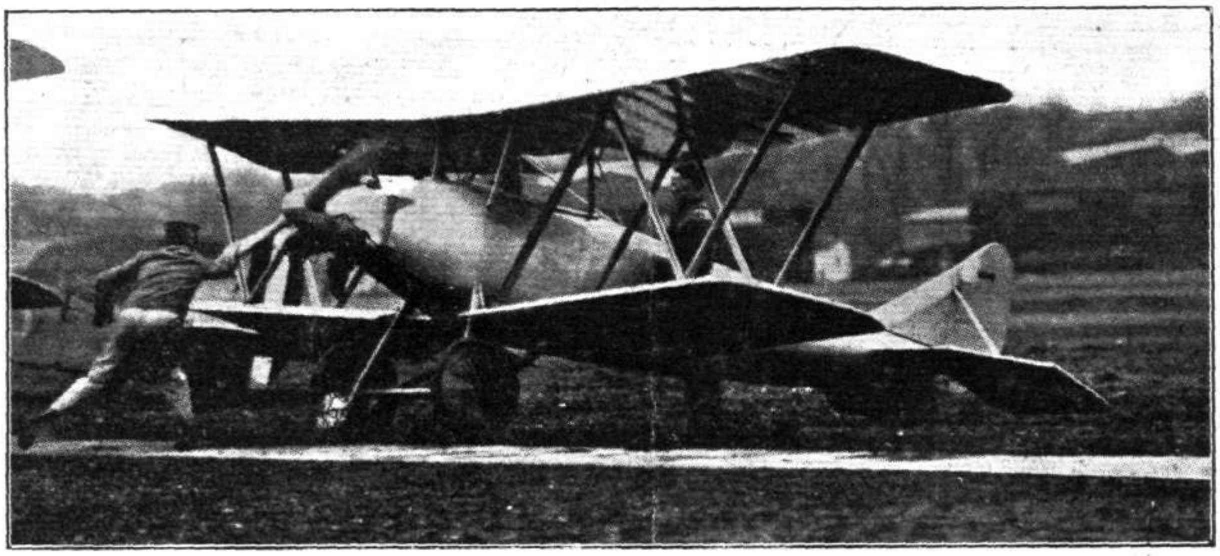
The Police team from Sunbury defeated the East Surrey Regiment in the final of the open tug-of-war, and the Hawker team won the open relay race.

The prizes were presented to the successful competitors by the wife of the managing director, Mrs. F. Sigrist, and proceedings terminated with an open-air dance, all having thoroughly enjoyed the sports day.

The whole arrangements were in the hands of a committee, with Messrs. Whitehorn and Scott at the head, and they are to be heartily congratulated on the result.

Those present included Mr. and Mrs. F. Sigrist, Mr. and Mrs. F. I. Bennett, Mrs. Hawker, Capt. L. F. Peaty, Mr. F. S. Spriggs, Capt. and Mrs. K. Robertson, Mr. Sellar, Mr. E. C. Neman, and Mr. R. W. Sutton.

AT THE HAWKER SPORTS : A tug-of-war and, below, the slow-riding bicycle race



A U.S. Navy Experimental 'Plane : The Longren biplane, 60 h.p. three-cylinder air-cooled Wright engine, about to start on a trial flight.

First Trials of Zeppelin ZR 3

THE large rigid airship, ZR 3, which has just been built at the Zeppelin Works at Friedrichshafen for the United States under the terms of the Versailles Treaty, made its first trial flight on Wednesday, August 27. Although weather conditions were far from favourable, this first trial was quite satisfactory, in spite of the fact that one of the engines failed during the test. After leaving the shed the ZR 3 cruised round Lake Constance, and then flew off in the direction of Lindau. About three hours later the ZR 3 returned to Friedrichshafen and made a perfect landing. Herr Flemming, a well-known Zeppelin commander, was in charge, and it is reported that 59 passengers were on board. Before leaving for America, on or about September 10, the ZR 3 will make further flights over Germany. The ZR 3 is 656 ft. in length, 90·6 ft. in diameter, and has a capacity of 2,472,000 cub. ft. It is provided with five 400 h.p. Maybach engines, one in the main forward control car, and the others in separate gondolas. The total lift is about 179,240 lbs. and the useful load, including fuel, spares, passengers and crew, is 88,190 lbs. Its maximum speed is 76 m.p.h. and the cruising speed is 56-68 m.p.h. The radius of action of ZR 3 varies from 3,500 miles (full speed) to 5,280 miles (cruising speed).

Armstrong-Siddeley Engine Successes

GRADUALLY the radial air-cooled engine is proving its value and the time cannot be far distant when the type will come into much greater general use than has hitherto been the case. As an instance we mention that the Armstrong-Siddeley "Lynx" fitted in the Avro seaplane used by the Oxford University Arctic Expedition has been doing excellent work in the far north. The following wireless measage has been received by the makers of this engine from Mr. George Binney, leader of the expedition :—"Lynx engine beaten furthest north flying record 80° 15′, working excellently in continuing seaplane work under rigorous conditions ; place full reliance on Lynx. Binney, Oxford Expedition, North Eastland." Yet another success has been achieved by Armstrong-Siddeley Motors, Ltd., with the passing, by a "Jaguar," of the new Air Ministry 100-hour type test. The "Jaguar" passed the 100 hours' duration, with additional high speed and maximum power tests, at a rated power of 385 b.h.p. Two other "Jaguar" engines had previously, in June, 1922, and March, 1924, undergone the 50-hour type tests at 325 b.h.p. and 360 b.h.p. respectively. We believe the "Jaguar" is the first and only aero engine to comply with the new 100-hour type test conditions.

A Machine Tool Exhibition

FOR those who are concerned with the building of aeroplanes or engines one of the most important exhibitions of the year is that organised by the Machine Tool Trades Association, which opens at Olympia tomorrow, Friday. There will be all sorts of machine tools and machinery for use in industry, and the magnitude of the display can be gauged from the facts that the aggregate weight of the exhibits is about 2,500 tons, and its value will be over £250,000. The exhibition will be open from 10.30 a.m. to 9 p.m. each day (10 p.m. on Saturday), and finally closes on Saturday, September 27.

PUBLICATIONS RECEIVED

The Original Book of the Ford. By R. T. Nicholson, M.A. *London :* Temple Press, Ltd. Price 2*s*. 6*d*. net.

Department of Overseas Trade. Report on the Economic Conditions in France ; June, 1924. By J. R. Cahill. *London :* H.M. Stationery Office, Kingsway, W.C.2. Price 6*s*. net.

Aeronautical Research Committee Report for the Year 1923-1924. *London :* H.M. Stationery Office, Kingsway, W.C.2. Price 2*s*. 6*d*. net.

Aeronautical Research Committee, Reports and Memoranda : No. 903 (*Ae.* 132).—The Prediction on the Prandtl Theory of the Lift and Drag for Infinite Span from Measurements on Aerofoils of Finite Span. By A. Fage and H. L. Nixon. December, 1923. Price 9*d*. net. *No.* 908 (*Ae.* 134).—Experiments with Rudders on Twin-Engine Aeroplanes. By F. W. Meredith. December, 1923. Price 9*d*. net. *No.* 911 (*Ae.* 137).—A Generalised Type of Joukowski Aerofoil. By H. Glauert, January, 1924. Price 6*d*. net. H.M. Stationery Office, Kingsway, London, W.C.2.

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